The Mining Journal
AND COMMERCIAL GAZETTE.

SUPPLEMENT---IX.

REVIEWS.

Birmingham and its Vicinity, as a Manufacturing and Commercial District: with illustrative plates. By WILLIAM HAWKES SMITH. Tilt, London; Radclyffes and Co., Birmingham.

The manufacturing towns of this country, in whatever light we view them, are objects of deep and well-merited interest, both in reference to their own local and peculiar characters, and as intimately connected with the greatness and prosperity of the British empire. In these densely peopled spots, we find congregated together, within the space of three or four square miles, a population which elsewhere would fill a province—every individual being skilled in some peculiar operation to which his time and attention have, from early life, been directed—every process of art nicely portioned out to each labourer, so as to render available the utmost amount of his skill—and the giant power of steam, acting through a thousand diversified and ingenious contrivances, performing every operation for which actual intelligence is not required. The crude products of nature, whether derived from the animal, vegetable, or mineral kingdom, in themselves of little use or value, here undergo an infinity of transformations, adapting them to the necessities, the comforts, or the elegancies of civilised life.

The economy of time and labour which we have noticed, and the introduction of the power of steam, and of mechanical contrivance, are not only the means of producing that transformation of the crude products of nature, which when practised on a large scale, is termed *manufacturing*, but what is of far more importance to the great mass of mankind, they are the means (by saving all unnecessary labour, and economising every material) of manufacturing *cheaply*, so cheaply that every individual is benefited by the articles produced, instead of, as would otherwise be the case, their being attainable by the wealthy alone, and their benefits thus limited to a comparatively small portion of mankind.

Among those great manufacturing towns of which England may justly be proud, as contributing so highly to her wealth and political power, Birmingham claims a distinguished place. Situated in the very heart of the country, on a fertile and salubrious spot, in the midst of a rich and highly-cultivated tract, possessing wealth, enterprise, talent, and immense population, and surrounded by a district stored with the raw materials of her manufactures, Birmingham may well claim the title of the *Metropolis of Central England*. The roads converge to her as a focus from all quarters, and canals radiating in all directions, supply the only advantage that nature has denied to her situation, or the vicinity of a navigable river. Nor has Birmingham been slow in benefitting by that new and magic creation of art, the rapid locomotion of steam, the railway connecting her with London, and which little more than another twelvemonth is expected to complete, is a work of unparalleled grandeur and magnificence; while another line, of less difficulty, but scarcely inferior in length, will shortly unite her with Liverpool and Manchester, the great centres of commerce in the north of England. A third line of railway, now commencing, will afford rapid access to the cities of Worcester and Gloucester, and thus open a communication with the estuary of the Severn and the Bristol Channel.

Nearly half a century has elapsed since Birmingham was termed by the eloquent Burke, "the toy-shop of Europe;" a title which appropriately designates the town in which such innumerable articles of taste and minor utility are manufactured, and from whence they are distributed over the whole civilised world. Yet Birmingham must not be considered as a toy-shop *only*, her manufactures embrace a much wider range than trinkets, jewelry, and hardwares. Fire-arms are extensively made here, the copper coinage of the country is supplied by the Soho-works, and we need hardly state that the steam-engine (we speak of it in reference to its present state of wide-extended utility) was here elaborated by the genius of Watt, in conjunction with the capital and enterprise of Bolton; and although the exclusive patent right has long expired, the manufacture of steam-engines and machinery is still extensively carried on at these works.

Although the antiquity of Birmingham may be traced back to a very remote period, it is only within the last century or two that the population and importance of this town, have held so prominent place; and it is worthy of remark, that it has never been indebted to (perhaps, we should say more correctly, *fettered by*) any corporate privileges, and that its rise has been achieved by the vigorous efforts of industry alone. This circumstance strikes us the more forcibly, when we recollect that during the same period those towns which have been swayed by corporate bodies, have in most instances been stationary, in some have even been going to decay.

Together with increasing opulence, architectural taste has also sprung up, and some of the new public buildings of Birmingham would be an ornament to the finest streets of London. The magnificent town-hall is justly regarded with pride; and for grandeur, solidity and pure classical taste, we should pronounce it superior to any modern building which the Metropolis can boast. The grammar-school in New-street, originally founded by Edward the Sixth, and for which a splendid range of building in the Gothic style has lately been erected, from the designs of Mr. Barry (the architect of the new Houses of Parliament), ought not to pass without notice. This structure is one of the finest modern examples of the Gothic style of architecture, it is massive, elegant, and well-proportioned, rivalling even the ancient and exquisitely beautiful specimens of this style, which most of our modern buildings have rather burlesqued than imitated. The grammar-school is yet scarcely finished, but forms both one of the finest ornaments of the town, and an undeniable proof of Mr. Barry's genius, and his qualifications for the important and national task which has been so appropriately assigned to him.

It is not our province to enter into a topographical account of Birmingham, or we might enumerate other instances of the wealth, the taste, and spirit of the town, as displayed in the public works which it exhibits; one example however we cannot pass over, we allude to the approaches of the railway from London, which are now forming on a most magnificent scale, so as to combine architectural ornament with engineering utility. On approaching within about a mile of the town, the railway passes through a deep cutting in a high rising ground, and immediately beyond this, commences a long and lofty embankment crossing the valley on the London side of the town, This embankment terminates on entering the town, by a viaduct, of considerable length, and of lofty and magnificent proportions, forming one of the most striking objects on the line, and emulating the grandeur of similar works constructed by the Romans.

We need scarcely observe that a town like Birmingham affords ample scope for description—not the mere dry description of ordinary topographical compilers, or the hasty production of modern tourists, but a work resulting from close powers of observation, and accurate local knowledge, containing matter interesting both to the general reader, the statistical and political inquirer, and the man of science.

The work before us appears to have been written upon the enlarged and comprehensive plan we have pointed out, and the author, uniting literary ability with accurate local knowledge, and a competent degree of antiquarian research, has thus produced a work very far superior to the generality of the class to which it belongs.

On first opening the pages of "Birmingham and its Vicinity," and glancing over the illustrations, which are numerous and beautifully engraved, we were rather surprised to observe some (chiefly at the end of the book) in which names and addresses were so prominent, as to give the work a rather *business-like* appearance. This circumstance was however sufficiently explained by the announcement which soon afterwards met our eye, that it was the wish of the publishers to combine with the literary pretensions of the work, the character of an "*ornamental directory*," and they had not therefore "hesitated to intersperse such *address plates* as in their apprehension might with propriety be so placed; whether as street views, or as in any respect illustrative, or appropriate to the contents of the adjacent pages." This is an arrangement to which the fastidious critic would no doubt make serious objection, but we are disposed to take rather a different view of the case. The English were sarcastically, but at the same time very justly termed by Napoleon, "a nation of shopkeepers;" and it appears to us quite in accordance with this national characteristic, that illustrations such as we have noticed, should be appended to the description of one of our busiest seats of manufacturing industry.

Considered merely as a history and description of Birmingham, the work before us would hardly have claimed so lengthened a notice in our columns, but that it is wisely made to embrace in addition, a pleasing and well-written account of the important mineral district, to the vicinity of which, the town is entirely indebted for its greatness and prosperity. In our notice of a late publication ("The Miner's Guide") some account was given of the great coal and iron district of Staffordshire; the subject is however too interesting and too important to be easily exhausted, we shall therefore proceed to make some extracts from "Birmingham and its Vicinity," in which the author has treated it in a very able and pleasing manner, although in so doing we pass over many interesting details of the early history of the iron trade.

Mr. Smith thus describes the geological and mineralogical features of the Staffordshire coal-field:—

"The total extent of the coal-field is, however, positively considerable; and may at present be stated to be circumscribed by a line, commencing near Stourbridge, and drawn through Kingswinford, Sedgeley, and Cannock, to Rugeley (its northern extremity), and returning by Beaudesert Park, through Walsall, West Bromwich, and Halesowen, to Stourbridge again; the known length being upwards of twenty-two miles, the greatest breadth about six miles, and its superficial content approaching ninety square miles.

"This circuit and this area are greater than those stated by Mr. James Keir in 1798;* or by Conybeare and Phillips in 1822; but each writer must, of necessity, be confined to the limits of the working of his own time. So long as manufactures and commerce proceeded in a regular course of increase, and coal in the smaller boundary was sufficient for the supply of the demand; but during the last fourteen or fifteen years the course of commercial transactions seems to have altered its character. Production is limited, not by the wants of the purchasing markets, but by the existing extent of the rapidly increased productive powers. Among other effects of this competitive and excited state, has been the ten times double demand for coal, as the ultimate agent in the fabrication of all manufactured articles. This demand has been met by the eager activity of the mine-proprietors, and naturally induced the opening of new ground, as has been stated, beyond the limits of what were, a few years ago, considered the bounds of the coal-basin; so that the extent of the dark space in the descriptive map must be given with diffidence, and subject to correction from the operations of future years.

"Throughout this important tract of country, the coal and iron-stone lie in various strata, with numerous interposed beds of different earths, as clay, rock, sand, &c. The position of the whole *respectively*, approaching to regularity, and having a general *dip* or descent as they proceed southward.

"Of the *coal* strata, the principal one is nearly thirty feet thick, and takes the descriptive appellation of *ten yard coal*. It abounds in impressions of vegetable forms; and it is remarkable, that these, in many cases, are such, as from their characteristics are judged to be natives of tropical climates. It were useless to speculate upon the possible cause of the apparent change of temperature in a given region, as thus manifested in its productions; nor can the naturalist satisfactorily theorize on the formation of coal itself. It is commonly said to be "of vegetable origin;" but setting aside the difficulty of conceiving of a quantity of vegetable matter, sufficient to form in *a firmly compressed state*, a body of coal, ten yards thick—it may fairly be questioned whether any process of fermentation or pressure could suffice, out of such a material, to produce a substance of the firm and stony texture of coal, without the influx of a saturating inundation of bituminous matter, which should insinuate itself into all the cavities and interstices of its receptacle.

"This rich bed of coal is confined to the southern half of the coal-field. Proceeding northward from the central point, it first loses its aggregate character; the upper portion being separated from the lower, by a gradually thickening layer or *parting* of earth; and at length, following the ascending slope of the entire stratification, the whole is lost, or *crops out*, as it is termed, near Bilston, beyond which the lower and minor strata are worked These beds, though their thickness is comparatively inconsiderable, are valuable as being near the surface and easily reached.

"We have observed that the general inclination or *dip* of the strata is from north and south, but there are various irregularities observable in this course. Of these the most remarkable are those in which the whole recumbent mass has been forcibly raised, bringing to view a thick bed of *limestone*, which in all probability is the primitive substratum throughout the district.

"The principal limestone ridge extends in an irregular and broken range of hills, from Sedgeley to Dudley, a length of four miles. Its angle of inclination varies from 45 to 80°, and as it has been raised from its original location, three hundred yards below the surface, the strata are found to incline *each way*; that is on the east side of the hill, the strata dip *east*, and on the west side *west*; tending to a junction at the summit, and sloping each way like the roof of a house.

"On the ascent of the hills, however, all appearances of regular stratification is lost, for at the time of the great convulsion of nature, a *cleft* in the various layers would be necessarily laid open, and a flattened summit gradually formed of the *debris* of the more friable materials, leaving the solid and firm ribs of limestone alone, unchanged. So likewise, in that portion of the coal-field, where the upper beds are said to *crop out*, it would be in vain to search on the surface for visible evidences of the presence of particular strata, the whole of the exposed parts having been, by atmospheric influence, and by the action of water, through untold ages, reduced to a mingled and heterogeneous, though undulated, upper soil or surface.

"Other elevations of limestone occur at the eastern edge of the coal district, near Walsall, though not in extent or magnificence comparable with those near Dudley. From all that can be observed, it appears that the arrangement of the strata is, generally, similar, and that it is the same continuous substratum of lime, which appears in both situations, and which gives to the strata of the intermediate country a hollow or curved section, appropriately called a *trough*.

"That the stupendous event which caused these elevations and depressions, took place *after* the numerous upper beds were deposited, is rendered evident by the regularity of their relative collocation, even where *faults* or fractures occur; the whole stratified mass being in such cases broken through, and elevated or depressed *together*. A remarkable fault or disruption of this kind runs through the *Bradley* coal-field, near Bilston, and proceeds in a southerly direction to a great length. On the *western* side of this fracture, with scarcely any intervening space, the main coal and all its attendant beds lie from 80 to 100 yards nearer to the surface than on the eastern side, thus rendering the lime accessible to the miner. Again, on the western side of the Dudley limestone hills, the course of the *dip* proceeds rapidly south-westward; but before the depth becomes so great as to place the ten yard coal out of reach, a fracture with a sudden elevation occurs, which raises the whole sixty or seventy yards; and the same phenomenon is again and again repeated, as the dip of the strata proceeds, so that a section of the strata through Kingswinford parish would somewhat resemble a staircase laid horizontally down. Another peculiarity attendant on this side of the coal-field, may be here mentioned; namely, that the main or ten yard coal, near Stourbridge, divides itself into three seams, separated by *partings* or layers of earths of increasing thickness; the total thickness of the three seams of coal, not exceeding seven to eight yards. Comparing this circumstance with the similar division of the main coal, observable near Bilston, it would seem that the *old coal field* is, in fact, the *centre* of the formation, which, at some distance on either side, tends to divide and lose itself. Such variations are, in fact, highly probable, if we consider, that although the coal was unquestionably deposited by the action of *water*, still its various layers, and those of the different earthy beds interposed, were laid down in succession, not in a properly *fluid state*, but in the form of a slowly advancing mass, similar, we may conceive, to the moving bogs of Ireland and Lancashire, which would admit of their lying in positions to a certain degree inclined; and accounts for the intervention of wedge-formed and partial strata of other materials.

The operation of mining is in all cases carried on as deep as the *main coal*, but not generally deeper; the extraordinary excavations made in the lime quarries of Lord Dudley have, however, exposed the course of the strata to a much greater depth. A subterraneous canal, two thousand yards in length, has been constructed with immense labour, connecting itself with the other canals in the neighbourhood, and branching out, in various directions, for convenience of working; thus eventually affording the facility of transit for the heavy material through which it is, in great measure, driven. Running in a horizontal plane through the highly inclined strata, this canal in its progress exhibits the nature and position of the various beds, nearly two hundred yards below the main coal.

"The limestone is very hard, so much so, that the entire mining operations in these strata are effected by blasting with gunpowder. They abound in the petrified forms of animals, which, without exception, are of *marine* species. These remains assure the observer that this bed of limestone was originally *the bottom of an ocean* teeming with animation.

"The iron ore is of the kind denominated *clay ironstone*; technically, a carbonated hydrate of iron, mixed with clay. The most esteemed is raised near Wednesbury, but it accompanies the coal, in greater or less quantities, through the whole district, in some strata being found in continuous beds, in others taking the form of *balls* distributed among the clayey and other deposits. In smelting, a quantity of lime is constantly thrown into the furnace, which combines, chemically, with the *clay* of the ore, leaving the metallic particles at liberty.

"Beneath the ten yard coal, after penetrating through several strata of mixed matter, is found another material, of great importance to the manufactures of the district. This substance is *fire-clay* (lencargillum), so called from its power of sustaining very intense heat with out fusing. This stratum is of considerable thickness, and varies much in quality, the best being found near Stourbridge. Its excellence, in fact, consists in its approach to the character of *pure clay*, nearly free from particles of lime and iron, both which are more easily effected by the action of fire. When first raised, this clay is of almost stony hardness, and of a leaden or slaty grey colour; it is, however, soon disposed to crumble on exposure to the air; it is then easily softened and tempered with water, and burns to a yellow or ochreous tint. The common brick clay derives its red colour from the oxide of iron which it contains; and the quality of the fire-clay deteriorates whenever it is found mixed with red or ferruginous spots.

"Fire-clay, as a vehicle or implement, is extremely serviceable in manufactures; it is distinguished into three qualities; of which the first and purest is used chiefly for the large pots or vessels in which glass is melted; the second for the crucibles used in refining of steel, and in melting metals for the founder; and the third is made into bricks for lining furnaces, and is also used as cement for laying the bricks in such buildings. This valuable mineral is sent to distant parts of the country where such a substance is requisite in the processes of art or manufacture. It is even exported to the West Indies, where it is used in the vessels employed in the preparation of sugar.

"The strata in the neighbourhood of Stourbridge are extremely disordered and shattered, so that the fire-clay, which lies low in the order of stratification, is, in many parts, attained without very deep sinking. At the *Hayes*, on the Birmingham road, occurs a remarkable elevation, which brings to the light a stupendous quarry of lime, which, with all the upper measures, dip from west to east. There is no corresponding slope *westward*, which would indicate that the first effort of the labouring vapour, produced a fissure at the extreme limit of its action. A *rise* on one side of the beach would then take place, while the land on the other side might be but little affected, or would, to a certain extent, sink. The beds of coal and earths, inclined at a high angle, are curiously exhibited in an adjoining cutting of the road.

"Thus this district produces to an unlimited extent the ore of the most important metal; the fuel by which it is rendered available; the *lime*, which, by its chemical affinities, expedites, or rather *permits* its fusion, when exposed to the proper temperature: and the peculiar clay, which, by its resistance to the action of fire, is materially serviceable in the various branches of the iron, as well as of some other manufactures.

"Several salt springs are found in the coal-field, in situations corresponding with the line of the principal faults. The brine probably rises from the strata below the line. On analysis, the water is found to be strongly impregnated with muriate of soda and lime; and to contain also muriate of magnesia and iron, and carbonate of lime, magnesia, and iron in small quantities. There is also combined with it a portion of carbonic acid and azotic gases. Of these springs, the one near Cradley is the most considerable. Some

* See Shaw's History of Staffordshire, vol. i. p. 116. The paper of Mr. Keir occupies about ten pages, and is highly interesting.

baths, and a house of accommodation of visitors have been erected, and it is increasing in reputation as a medicinal spring.

"The remaining substance, of which we have to make mention, is of no value in manufactures, but it is of a singular nature, and interesting from its position and characteristics.

"Near the point where the limestone hills terminate, a little to the east of Dudley, commences a range of elevations of entirely different components, extending in a south-easterly direction to Rowley Regis; the various eminences being distinguished by different names. In these hills a species of rock of the kind denominated *trap* or *basalt* prevails; which, from its hardness, is much used in the repairs of streets and roads, and which, from the situation of its principal quarries, is commonly denominated *Rowley Rag*. This stone appears in several places externally, assuming striking and bold configurations; and presents itself to the geologist in a questionable form. It is not a *stratum* originally deposited either *above* or *below* the limestone; for neither of the two substances is ever found to range or correspond in position with the other. It is obviously not *diluvial*, for it bears no trace in its composition, of the horizontal action of water; neither is it *primitive*, for coal is found extending *beneath it*. Of course its formation, in the places it now occupies, must have been *posterior* to that of the coal. The only rational conclusion, therefore, is, that it was ejected in a fluid state, from the bowels of the earth, through a chasm opened by the force of elastic vapour. The action of fire is also observable in the appearance of coal, which, in the immediate neighbourhood of basalt, is completely changed in quality; decomposed; reduced into a state resembling old exhausted coke.

"In fact, careful analysis and comparison have shown that the *basalt* of this district is identical with the *lava* which is known to issue from volcanoes at the periods of their eruptions; and the various forms it exhibits when exposed, may, probably, be referable to the greater or less rapidity with which it underwent the process of *cooling*. Of these appearances, the most remarkable is the *columnar*, so perfectly developed in the Giant's Causeway, in the north of Ireland, and distinctly, though less regularly, discernible in some of the quarries of this neighbourhood. This character would arise from the gradual *contraction* of nodule after nodule, mass after mass, as the process of refrigeration slowly proceeded; thus, naturally producing spaces or fissures between each of the *piles* or *sets* of nodules. In other situations, less of this arrangement is perceived; perhaps, because of the different degree of fusion in which the material was ejected; or because the masses being from some cause more detached, the cooling proceeded rapidly and without allowing time for more regular crystallization.

"Basalt is composed of various earthy and metallic substances, and may be considered as partially vitrified. Its power of resisting the action of air and moisture, varies in different situations. In some instances it is little affected by long exposure; in others it is speedily disintegrated, and there is little doubt that the *clays* which prevail in the neighbourhood of basaltic rocks, are no other than the same hard substance, decomposed by the gradual action of water and air, and reduced to its original state. In some of the quarries at Rowley, the surfaces of the balls or nodules are soon affected by exposure; and chip or peel off in concentric shells or layers, each of which, in its turn, pulverizes, and is reduced to the state of adhesive clay; and the face of a quarry which has remained long unworked, is generally found to lose its slaty hue, and to take a yellowish or ochreous tint. The quantity of iron in this substance is considerable, insomuch that it affects slightly, but perceptibly, the magnetic needle.

"The observer of the great operations of nature, will be well rewarded by an excursion to the neighbourhood of Rowley Regis. The old extensive quarry at *Pearl-hill*, between the Rowley and the Oldbury roads, presents an interesting sample of the columnar, or *ladder*-like crystallization. The height of the precipitous escarpment is from from forty to fifty feet, and the perpendicular chamellings, and the separation of the masses forming the columns, decidedly marked. The explorer will also be gratified by a farther ramble over the brow of the hill, which commands an extensive panoramic view over Dudley, Tipton, West Bromwich, Oldbury, and a wide horizon of flat but busy country, swarming with population, varied by industrial edifices of various kinds, and veiled by the perpetually rising volumes of smoke. Down the sides of this hill, also, wind some curious specimens of the original roads; deeply hollowed water-ways, with rough stony bottoms, shadowed by steep banks and hanging foliage, which, for half a mile together, almost shut out the light of day. Again, on the *south-west* side of the Rowley range, a boldly projecting front of basaltic rock, known familiarly by the name of the *Hailstone*, rises from the steep side of the hill, and presents a magnificent contour of solid durability and repose, marked and indented by deep but irregular cracks and fissures; the whole assuming, at a little distance, the mimic semblance of castellated masonry.

"If unwearied by the toils of his research, our inquirer will do well to cross the coal-field to Walsall, where, as has been observed, occurs another extensive elevation of the lime. In the neighbourhood of that town, also, a very striking exhibition of the rag or basalt offers itself. This is situated in a triangular copse of wood, on the summit of an eminence called *Pouck Hill*, on the right of the road, nearly two miles from Walsall, in the direction of Wolverhampton; and equally distant from Bentley Hall, and from the iron-works erected by the Earl of Lichfield. The spectator is here placed in the enjoyment of a novel and singular scene. He stands on a rich and beautiful grassy lawn, flanked and shut up, in utter seclusion, by a thick plantation of young trees; and before him rises in impressive grandeur, divided into two distinct masses, like well-arranged heaps of large sized and roughly squared timber trees; or rather, like the ruins of an ancient amphitheatre,—the sought-for *basaltic pile*. It is composed of *columns*, not placed perpendicularly, but laid in an inclined,—in some cases, an almost horizontal position; well defined, their faces sharp and smooth, their terminations square and decided, as if cut off by the saw. Another peculiarity is the curved form which prevails through the greater number of these columns, and which, in many, is considerable, and very regularly turned. On the whole, situation, form, and position, combine to render this one of the most interesting spots, both to the geologist and to the general inquirer, that the district affords.

"Such then are the grand features of the *ancient* geology of the portion of country which we have selected for description. Various other useful materials occur in different situations. Some considerable quarries of hard stone, for building and other purposes, are worked near Bilston, at Gornal, Tipton, &c.; and among the *diluvial* deposits are large beds of fine and valuable gravel. Sand abounds in all directions, and clay for building is found in almost every neighbourhood."

We regret that want of space will not allow our notice of this volume to be completed in the present Supplement, we shall, however, return to it at an early opportunity.

The Railway Magazine, and Annals of Science; containing copious accounts of all Railways at home and abroad; notices of Inventions and Scientific Discoveries. By JOHN HERAPATH, Esq. Vol. I. New Series. Wyld, Charing-cross. 1836.

The number of the *Railway Magazine* for the present month completes the first volume of the new series, which, under the able editorship of Mr. Herapath, has not only risen high in public estimation, but obtained that enlarged circulation which the value of the work and the importance of the subject well deserve.

The present volume contains numerous scientific papers of great value to the railway engineer, most of them contributed by the editor, whose well-known mathematical talents are thus brought to bear on many subjects of great practical importance. Among these, we may particularly direct attention to the articles entitled "Mathematical Laws of Railway Transit," and "On Laying out Lines of Railway," as calculated to be of great utility.

We are glad to find by the preface, "that nine months have seen the gross returns of the work rise to between six and eight times what they were previously." After making this quotation, it would be superfluous to enter further into the merits of a work, the value of which has been so well appreciated by the public.

AEROLITES.—A short time since an attempt was made to prove that, amongst all the different descents of aërolites, there was not a single account of any one being killed by them. Since then M. Babinet, son-in-law to Professor Laugier, has sent a note on this subject to the French Academy of Sciences, with a fragment of an aërolite, belonging to the collection of M. Laugier, which fell near Roquefort, in America, and, making a hole five feet in size, crushed two men in a cottage by the falling in of the roof. M. Eyrié also states, that Olaüs Ericson William, a Swedish sailor, in the Dutch East India Company, 1647, had declared, that whilst at sea, and the vessel under a press of sail, a stone, weighing eight pounds, fell on the deck, and killed two men. Mr. Warden has communicated to the Academy, that an event of the like nature took place in Georgia, in 1825, and occasioned the death of several persons; and, moreover, that in July, 1829, an Indian, named Alika, lost his life in the same manner.

A LECTURE ON THE PHENOMENA OF METALLIFEROUS VEINS,

DELIVERED AT THE PENZANCE INSTITUTION, ON TUESDAY, NOV. 29, BY W. J. HENWOOD, F.G.S. LONDON AND PARIS, ASSAY-MASTER OF TIN IN H. M. DUCHY OF LANCASTER.

We have been much gratified by the perusal of a very able and interesting lecture, "On the Phenomena of Metalliferous Veins," lately delivered at the Penzance Institution, by Mr. Henwood, and reported at considerable length in the *West Briton*. It is well known that this gentleman has devoted several years to indefatigable research in the mines of Cornwall, and we are pleased to see the condensed result of his labours thus made public, previous to their appearing at length. We gladly comply with the wish he has expressed, of re-printing the lecture in the *Mining Journal*, and feel we shall be benefitting our readers by giving increased publicity and wider circulation to the very interesting views which Mr. Henwood has propounded.

The CHAIRMAN, Dr. Boase, Secretary of the Royal Geological Society of Cornwall, opened the proceedings, by stating, that having himself given a lecture on *Geology* generally, it was intended to take the various departments in detail. In this course it would have been his object to have described the primary, or non-fossiliferous rocks, leaving the subject which would form the present evening's lecture to follow it. But the question of the origin of veins had been recently taken up by Mr. Fox, and having deservedly attracted so much attention, it had been thought advisable to follow it up whilst the impression remained. Mr. Henwood had for several years been engaged on the subject, and had inspected most of the mines in this and the adjoining county; the results of his labours were in a state of forwardness, and would shortly be before the public, in the fifth volume of the Royal Cornwall Geological Society's Transactions.

The LECTURER said, that it had been originally his intention to have refrained from publishing any of his observations, or the views to which he had been led by them, until he could do so in a connected form; and in this determination he had for some years persevered. Finding, however, that the views from which he almost entirely dissented were before the public, on the high authority of a gentleman for whom he had the greatest respect, and to whom he felt himself much obliged, he had thought it might not be improper to give an outline of them; and he felt the more satisfaction in doing so, as he believed they were in unison with the opinions of almost all the practical men of this county.

Before, however (he continued), we proceed to inquire into the origin of mineral veins, it may not be out of place to inquire "what a mineral vein is?"

"Veins or lodes," says Mr. Burr, "must be understood to be the contents of what have been originally *cracks* or *fissures*, traversing rocks longitudinally, and descending into them at various angles with the horizon, but usually much inclined."

Mr. Carne says "By a *true vein*, I understand *the mineral contents of a vertical or inclined fissure, nearly straight, and of indefinite length and depth*. These contents are generally, but not always, different from the strata, or the rocks which the vein intersects. *True veins* have usually regular walls, and sometimes a thin layer of clay, between the wall and the vein; small branches are also frequently found to diverge from them on both sides. *Contemporaneous veins* have been usually distinguished *from true* veins by their shortness, crookedness, and irregularity of size, as well as by the similarity of the constituent parts of the substances which they contain to those of the adjoining rocks, with which they are generally so closely connected as to appear a part of the same mass. When these veins meet each other in a cross direction, they do not exhibit the heaves or interruptions of *true veins*, but usually unite. When they meet *true veins* they are always traversed by them."

Mr. Burr remarks, "*Contemporaneous veins*, or veins of *segregation*" (a term borrowed from Prof. Sedgwick), "are those which appear to have resulted from a chemical separation of certain mineral and metallic particles from the mass of the enclosing rocks, while yet in a soft or fluid state, and the determination of these particles to particular local situations."

Playfair, the great illustrator of the Huttonian theory, observes, "veins are of various kinds, and may in general be defined separations in the continuity of a rock of a determinate width, but extending indefinitely in length and depth, and filled with mineral substances different from the rock itself. The mineral veins, strictly so called, are those filled with sparry or crystallized substances, and containing the metallic ores."

Werner defines veins to be "particular mineral depositories of a flat or tabular shape, which in general traverse the strata of mountains, and are filled with mineral matter, differing more or less from the nature of the rocks in which they occur." He adds, "all *true veins* were originally and of necessity rents open in their *upper* part, which have been afterwards filled up from *above*;" he continues, "The vein *after its first formation*, may have been *again opened* up;" and he considers the parallel layers, of which veins sometimes consist, as the deposites after such successive openings.

Professor Sedgwick says, "In all the crystalline granitoid rocks of Cornwall, there are also many masses and *veins of segregation*. Such are the great contemporaneous masses and veins of schorl-rock: and some of these are metalliferous. The decomposing granite of St. Austell moor is traversed, and sometimes entirely superseded, by innumerable veins of this description. Upon these lines of schorl-rock there is often aggregated a certain quantity of oxide of tin, which diffuses itself laterally into the substance of the contiguous granite." After having examined it he "left it with the conviction that several of the neighbouring tin-works were not opened upon *true lodes*, but upon veins of segregation."

In my own opinion, however, the best description of the *veins of this county* (and of these alone unless the contrary be expressly said, I beg to be understood as speaking) is given by Dr. Boase, in his valuable memoir on the Geology of Cornwall, in the fourth volume of the Cornwall Geological Society's Transactions. I concur most fully in every one of his statements; and the nature of the relations between the veins and their containing rocks, are so well described, that were I to attempt one of my own, it would be but a repetition of the same ideas.

The veins of Cornwall have no determinate size, being sometimes very narrow, or exceeding several fathoms in width: extending sometimes to a great length and depth, or terminating after a short course in either direction. As regards their form, they are occasionally, though rarely, contained within parallel, and regularly inclined sides or *walls*: but are continually varying in width, both on the line of their course and of their inclination; partaking often of the same undulating, and even curved, form of the rocks which they traverse: moreover, they are accompanied on either side by innumerable branches, which extend in various directions. And, lastly, a parallel series of veins frequently meets a cross-vein, either on the line of its course, or of its dip: some of these veins continue their direction on either side of the cross-vein; whilst others, on the opposite side of the cross-vein, abruptly disappear, on the line of their original course, and are often found at some distance therefrom, but running in a parallel direction."

On a small scale, as in the granite of Carclaze, and in the slate of St. Agnes, these branched and intersected veins are beautifully illustrated, parallel ramifications may be seen departing from either side of the veins; and in the case of intersected veins, they sometimes preserve the same course on both sides of the cross-vein, but often exhibit the peculiar arrangement called by the miner *a heave*.

Veins vary very much in their composition: in general, they consist entirely of earthy minerals, which, indeed, even when the veins are metalliferous, constitute the greater part thereof, the ores seldom being continuous for any considerable distance, but being scattered and desseminated throughout the matrix in short irregular veins, layers, bunches, granules, crystals, and smaller forms; sometimes, indeed, but rarely, except in very small veins, the ore entirely prevails.

The prevalent idea of Cornish *lodes* is, I believe, rather imperfect; and those who suppose veins to have regular walls, and to have been derived from fissures, would not recognise as such, layers of schorl-rock, of porphyry, of hornstone, and even of granite itself; but these are called lodes by the miners (Mr. Carne states that in Huel Unity the *elvan* is so rich in tin, that it is considered as the *tin lode*) when they abound in metallic minerals. Even the most regular tin and copper *lodes* are very complex in their composition; quartz generally prevails in their matrix, but is always more or less blended or mixed with a substance similar to the adjoining rock; indeed, the latter often occurs in distinct forms, as nodules, angular pieces, and even masses of considerable size, which are independent of the main rock, being completely enveloped in the quartzose part of the lode: these are of such common occurrence, as to have been named by the miners *horses of killas*. Sometimes the schist abounds in the *lode* that the quartzose part altogether disappears, or is only continued in minute strings; in this case the *lode* is said to have *dwindled away*, or to have been *wrung out*. It also frequently happens that both these principal parts (the rock and the quartz) are intimately united, producing a siliceous layer of rock which is still metalliferous, and is commonly called the *capel*; hence the courses of schorl-rock, porphyry, and some anomalous rocks which have been called by the miners *elvans*, have been properly considered by them to be analogous to *lodes*, for they are, in fact, veins on a larger scale.

It has been already stated, that the *elvans* pass by gradual transitions into the adjoining rocks; and it may be mentioned, that the same intimate connexion which subsists between the quartzose part of veins and the included portions of slate (*horses* of killas), also obtains between the veins and the main rock. I have invariably found that this phenomena is, common to the metalliferous veins of Cornwall. This fact appears to explain why the matrix of lodes bears a relation to the containing rock; and why the metallic contents of *lodes* in like manner vary both in their nature and quantity.

From the same authority (Dr. Boase) in his valuable "Treatise on Primary Geology," we learn that large metalliferous veins, like the lesser ones, which are confined to rock concretions, though they may sometimes appear to have walls or way-boards, yet these are not essentially necessary, being often only found in certain parts of the veins, and may therefore be attributed to accidental circumstances, such as the peculiar manner in which the substance of the lode was aggregated; the occurrence of a smaller vein of a different mineral parallel, and sometimes coincident to the sides of the larger, but far more frequently to the subsequent formation of seams or fissures, by the alteration of the rock at the junction of the veins resulting from decomposition, the effects of the percolation of water, or of the action of the elements. How can we otherwise account for the fact that many parts of those veins, exhibiting what have been called regular walls, are intimately connected with the adjacent rock, not only as it were by a mechanical union, but often by a transition of mineral composition, so that in granite the union is generally effected by the rock becoming gradually more and more quartzose, and in the slate it is also accomplished by the latter undergoing a like change? Sometimes indeed the vein itself, at these points of union, appears to partake of the nature of the containing rock; but much more commonly it entirely includes portions of the rock of various dimensions, according to the size of the vein.

These *horses* are of the same nature as the contiguous rock, being slaty when the *walls* of the vein are slate, and granitic when they are of granite.

As a general fact, though with innumerable exceptions, it may be said that tin ore prevails in the granite, and copper ores in the slate; notwithstanding it may, perhaps, be true, that the largest *single* masses may have been found in the opposite rock, of tin ore in slate, at Wheal Vor, and of copper in the granite, at Tresaveau; for example, a pretty fact of the prevalence of different ores in various rocks, I noticed in Botallack. There were two or three alternations of granite and slate of no great extent; the *lode*, when in the granite, contained tin ore, and when in the slate, copper. Indeed, it is a very well known fact, that the same vein is seldom productive in two different rocks; thus the immense mass of tin ore, I believe more than a million sterling worth, in Wheal Vor, was in slate, whilst the same vein is entirely unproductive in the granite. The adjoining mine of Great Work gives all its tin ore in granite, and is poor in the slate. Again, the *lode* of Tresavean yields its copper ores in the granite, being worthless in the slate; whilst the neighbouring mines have given almost the whole of their copper in the latter. These respectively are on parallel veins. There is a prevailing proverb of "ore against ore," meaning, that in the same neighbourhood there is a greater probability of it in parallel veins, near the same north and south line, than eastward or westward, even on the same vein.

It has been already quoted that even the richest metalliferous veins contain, compared with their total mass, but a small proportion of ore, and that this is irregularly distributed; these masses are called *shuts* or *shoots*, and appear by their dip in the vein as if obedient to some influence of the granitic masses in their vicinity, always dipping *from* and seldom *towards* them; indeed, I have not met with an instance of the latter.

It is also one of the most generally recognised facts, that veins of copper or tin ore, when productive, are much more nearly perpendicular than when inclined, and when a change of dip takes place, it is almost immediately succeeded by an alteration in the contents of the lode.

I am disposed to suspect that grey (vitreous) copper ore occurs more generally in granite and massive slate rocks than in the schistose rocks; and that the copper pyrites is most abundant in the latter. I am, however, aware that there are many and considerable exceptions.

It is by no means uncommon to find masses of ore close to cross-courses.

But the *elvan courses*, of which I have already spoken, are supposed to play no insignificant part in the economy of the metalliferous districts. They are frequently several fathoms in breadth, and are chiefly composed of a basis of felspar and quartz, containing porphyritic crystals of both these minerals, and frequently of many others. As a general rule they are intersected by the metalliferous veins, cross-courses, &c., but they are seldom *heaved*; a case, however, of an elvan course *heaved* by a fluccan occurs at Swan-pool, near Falmouth, and has been well figured and described by Mr. Thomas; whilst at Polgooth, the *elvans heave* some of the *lodes*. In the vicinity of these veins many of our mines have been very productive; of tin at Polgooth, Wheal Vor, and the Wherry; and of copper at the Consolidated and United Mines, Ting Tang, Treskerby, Dolcoath, Wheal Alfred, Wheal Fortune, &c. At the Battery rocks here (Penzance), at Swan-pool, before mentioned, and at St. Agnes, the *elvans* are beautifully shown on the coasts.

Having now briefly described the contents of the lodes, and the composition of the elvans, which vary too in their composition, whether they occur in slate or granite, we have to see of what the *cross-courses* consist. They are generally of quartz, which is often of a peculiar radiated structure, with abundance of clay; and when the latter prevails they are called *fluccans*. *Cross-courses* and *fluccans* change their character very frequently; depending also on the nature of the rock they traverse. *Slides* are often veins of clay only; but they also often become quartzose, and sometimes, as in some at St. Agnes, they are metalliferous.

The *directions*, or bearing of the greater number of *metalliferous veins* in this county, are within a few degrees of magnetic east and west; of the *slides* nearly the same; the *elvans* are generally rather more to the south of west and north of east than the *lodes*; whilst the *cross-courses* and *fluccans* bear within a few degrees of north and south. There is, however, a metalliferous series of veins, the *contra or counter lodes*, which have a strike of about north-west and south-east; whilst the *lodes* of the parish of St. Just are about north and south, and the *cross-courses* or *guides* about north-east and south-west.

It is a general fact, that there are seldom or never *in the same district* two metalliferous series at right angles to each other.

The rocks too are traversed by lines of symmetrical structure, the (queres) which have a kind of a rough approximation to the directions of the veins; one of the principal sets bearing about north and south, whilst a second stands about east and west, and a third somewhere nearly north west and south-east.

This coincidence (so far as I know) was first alluded to by Dr. Boase, who says, "it has often struck me that the large veins correspond with the seams of the layers of rocks, and the smaller ones with those of the component blocks and laminæ of these layers; I have repeatedly detected this coincidence." The subject has recently attracted the attention of Professor Phillips, Professor Sedgwick, and Mr. Hopkins, and all these excellent observers, have given some admirable details of great value.

Whether these be synchronous with the rocks themselves, or of posterior origin, has lately been discussed by Dr. Boase and Mr. Hopkins; the former maintaining the affirmative, the latter the reverse. It is well known that these lines traverse, often without interruption, the granite, slate, elvans, and veins; although sometimes the same want of coincidence, which in the case of *lodes* is called a *heave*, is observed. It is, I think, clear, that if produced in the slate by any dislocating elevation, the *lodes* must have been contemporaneous with that movement, if not anterior to it; for it is scarcely possible to think that any which had existed in the rocks previously to the formation of the veins, would

have been prolonged from each side through the latter with such exactness. It cannot be doubted that this veiw of their contemporaniety, very much simplifies any idea of their origin.

When two veins, having different directions, meet *horizontally*, one often intersects the other, the portions of that cut through not being found exactly opposite each other, on the different sides of the traversing vein, but by turning either to the *right* or to the *left* hand. The *right* and *left* hands are familiarly employed by practical men in preference to the points of the compass, as on whichever of the divided portions we approach the intersecting vein, the *heaved* segment will be found on the same hand.

When veins intersect vertically in *descent*, this want of coincidence is called a *slide*: a few of these occur in many parts of the county, but they are most common in St. Agnes and Gwennap; whilst the *heave* is of almost universal occurrence, being found of greater or smaller extent in every mining district of Cornwall.

A little consideration of the phenomena will show that the latter may occur *alone*, if the veins have a horizontal parallelism, and the former *only* if *horizontally* at right angles; whilst if there be any intermediate directions—at certain points in their extent, one;—and at others, the other of them will obtain.

A great point in dispute is, were these opposite portions ever united? it being an axiom of Werner's, which has been adopted by all the advocates of these originating in mechanical disturbance, "*that a vein which is intersected, or traversed, by another vein*," "is older than the vein by which it is traversed."

In this investigation we are not to consider that the phenomena in question are their own explanations, or that the fact of an intersection is *a proof* they were ever united; it is evidence of an independent nature we require.

My distinguished friend, Professor Phillips, says, "How can the geologists of Cornwall doubt the reality of those angular movements, which have left such clear evidence as the fine slickensides of some of their veins of fissures?"—If this acute observer had enjoyed such facilities for examining these as I have, he would have remarked that, polished as they are, they are very irregular, and that the depressions are equally bright with the elevations; the striæ, too, are seldom parallel, and on opposite sides of a vein they have often reverse dips; it is by no means unusual to see them curved, contorted, and irregular, as a piece of crumpled paper, intersecting each other in all directions. I think it will be allowed that this is not "clear evidence," or, if so, at all events not in favour of motion. The earthy contents of *lodes* and *cross-courses* present the same glittering and striated faces, and with like complications, with still greater frequency.

Following the idea of intersection being an index of the ages of veins, Mr. Carne, some years since, attempted a classification of Cornish veins, of which he made eight different ages—older and newer tin lodes; old, newer, and newest copper lodes; cross-courses, cross-fluccans, and slides: the exceptions given in his instructive publication are, however, as numerous as the cases on which the subdivision is founded.

The great argument in favour of the mechanical displacement is supposed to be derived from the accordance of facts, with what would obtain were an *elevation* of the *one side* of the traversing vein to take place.

This ingenious idea, so far as I am conversant with its history, was first propounded by a German geologist (the late Herr Schmidt), and was long since submitted to mathematical analysis by Zimmermann, in his publication, "Gänge, Lager, and Flötze;" and lately Mr. Hopkins, in his "Researches in Physical Geology," has placed it in an English dress. So long ago as 1831, I submitted an outline of it to the Geological Society of London, which, I believe, was little noticed; I shall again speak of the contents of the paper in which it was inserted.

It is not easy to explain, unless at great length, by words alone, or even with diagrams, the results of motions on given planes of systems of lines not coincident; but models of Herr Schmidt's contrivance have been constructed, which beautifully and simply illustrate his theory. We will suppose two *lodes* nearly parallel in direction, but having opposite dips towards each other in descent, giving a large V on the end view; fractured nearly at right angles to their direction, and the portion on one side of the fissure to be elevated vertically. It is plain that the *lower and narrower part of the* V *on the elevated side, will be brought opposite the upper and wider portion of the letter on the unmoved side.* Let us then imagine all the portion elevated above the former surface to be removed, and take a view of the horizontal plan presented, we have the fissure representing a *cross-course*, and one of the fractured veins will be *heaved* to the *right*, and the other to the *left*. If both veins had dipped the same way, it is obvious they would have been heaved the same way: whilst if the line of elevation, instead of being vertical, had been coincident with the dip of one of the veins, and the two were not parallel in dip, one vein would be merely intersected, whilst the other would be *heaved*.

This beautiful and ingenious illustration exhibits very satisfactorily that if the dip be irregular, so, in proportion, will be the distance of the *heave*.

It is also evident that these *are not only possible, but* INEVITABLE *results*; and that if two veins, having opposite dips, be displaced by the same vertical motion, it is "*physically impossible*" that they can be heaved otherwise than towards *different* hands. The object of my already-named communication to the Geological Society was to show that this county afforded instances inexplicable on any one simple motion assumed; but, for reasons with which I was never made acquainted, this paper was kept by the officers about a year before it was read to the Society. Professor Phillips says, "several remarkable cases which occur in the mines of Cornwall have been simply explained by Mr. Lonsdale." I presume those I gave are intended; but it would have been desirable to have known what number of them was left unexplained. Moreover, we are, I think, restricted rather within the limits of bare possibility; and tied to probability too; are the motions required for simple explanation likely? Is there any evidence of their occurrence but their convenience? For if allowed to assume motions of any masses, by any forces, to any distances, and in any times required, our limits will be indeed extensive.

We will now see how nearly this most beautiful theory coincides with the facts; in Cardrew Downs, Wheal Trenwith, and Wheal Bolton, parallel *lodes* with *different underlies are heaved the same way by the same cross-course*. Such things, with a vertical motion, are *totally at variance with it*. But let us see if oblique motion will help us; at Dolcoath (a beautiful fact kindly pointed out to me by Captain Petherick) an *elvan* course and two veins dip northward; all three are traversed by a *cross-course*, the two veins are *heaved different distances, but both to the right; and one of them is heaved from the killas into the elvan, whilst the elvan itself is not heaved*; while still continuing northward *the same cross-course is itself heaved by an east and west vein*. It is clear that an oblique motion on the line of the dip of the upheaved vein (the *elvan*) will not satisfy all the conditions.

In the same mine the same intelligent gentleman describes a case recorded by Mr. Fox, where one *lode heaves* another at one depth, whilst at a different one it is itself intersected by the same vein which it had *hove*.

Slides are supposed to be the results of similar movements shown on a transverse section, and *primâ facié*, the want of coincidence is far more striking. But have we any greater evidence of *mechanical* disturbance than in the preceding case? In the well-known section of Wheal Prever we have one case of the vein in the hanging wall being the *lower*, and two of the same wall being the *higher*. In Mr. Carne's section of Treskerby, the hanging wall in four cases seems the higher; whilst in Trevaunance (from the same authority) we have five cases of the contrary. In Herland there is a fine case of the *foot* wall being the lower, and in South Wheal Towan, where the contrary obtains, the *slide* in one spot is split into two, and a portion of the vein is contained between them—whilst above and below these unite and form one vein only. There appears no greater harmony here, than in the cases of *heaves*.

Professor Phillips well remarks, "It is, besides, no argument for one theory that another is beset by difficulties which are left unexplained in both." Having, however, stated these objections to the prevailing theory, it is not the point at issue for its advocates to show that any hypothesis I may have, if I have one, is equally objectionable; but it is for them either to show how their theory applies to any facts; or if a theory we must still have, to modify the existing one so as to embrace them.

We know, however, as was well stated by Mr. Grylls, at Redruth, in remarking on Mr. Fox's excellent lecture, that the same phenomena are exhibited in hand specimens, the same apparent *heaves and slides*, is it contended that these are also mechanical disturbances?

I must conclude this brief notice of the phenomena with expressing my inability to lay down, or to concur in any diagnostic characters of the small veins of this county, which are not equally applicable to our great metalliferous systems.

We now come to the consideration of the theories which have been propounded for the explanation of the *origin* of mineral veins, and here I hope I may be permitted to pay my humble tribute of admiration and respect for the illustrious *Werner*. His views of the origin of many rocks have been rejected, his opinions of the filling of veins have in many cases been abandoned, but his idea of the veins having originated in fissures has been adopted by all his successors. Strictly speaking, I believe the notion of cracks had its origin as far back as Agricola; but Werner in Geology, like Newton in Physicial Astronomy, combined and collected all the beautiful fragments elaborated by his predecessors into a structure, objectionable, perhaps, in some of its arrangements, but in the department of which I am now speaking, so far beyond any thing that I believe, without his labours, even the present day would erect, that whether our veins be large or small, of sudden or progressive formation, of *horses* and their supports, all the leading views, and all the principal phenomena described by him, have been adopted by successive theorists.

Fissures being then the common postulata of all the theories, excepting of that of the practical men of this county, and which supposes the contemporaniety of the rock and veins, let us proceed to an examination of the grounds for the assumption.

Werner, imagining all rocks to have been originally deposited from aqueous solutions, says, "the shrinking of the mass of a mountain, produced by desiccation, and still more by earthquakes and other similar causes, may have contributed to the formation of veins." Hutton thought that elevatory forces acting from beneath, originating in paroxysmal protrusions of liquefied matter in the interior of the earth might have caused them. It has also been supposed, that the earth may have been originally in a state of igneous fusion, and that as its temperature diminished the external crust would crack during its cooling. Mr. Hopkins has investigated mathematically the results which would obtain in a homogeneous mass acted on by an elevatory force, and concludes, that it would induce "two systems of fissures with a certain general approximation subject to certain modifications to rectilinearity, and perpendicular to each other." Those at intermediate angles must therefore have originated at different times. Were each system to have been completed at one paroxysm, we should have many such, but where we have, as in the metalliferous districts of this county, veins in every direction, which both Mr. Hopkins and Mr. Fox think may have opened "gradually or at intervals," many of them many times "opened up" the elevatory forces must have been almost continually at work on one system or another. But Mr. Hopkins has shown that *parallel* systems of fissures *must inevitably* have been synchronous. Now in many of our mining districts the *lodes* form no inconsiderable portion of the whole mass of the earth; often, indeed, between two, the rock is not very many times wider than one of them; what would have kept open these thin masses of rock, usually much inclined "and of indefinite length and depth?" The *horses* (in the north they are called *riders*), replies the advocate of fissures. Why then, I reply, do we find no portion of the upper rock (killas) fallen into the subjacent granite? And why are the *horses* entirely surrounded by the vein; for until the substance of the vein was deposited, what supported it? Werner, Mr. Hopkins, or Mr. Fox replies, at first it was a mere crack or narrow fissure kept open by the rubbish falling. I rejoin, if we must have a crack and props to keep it open, is it more difficult to keep abroad a wide than a narrow fissure? If we must support the same weight, may it not be as well kept a yard as an inch apart? Mr. Fox has said "veins are often divided into branches, which unite again at considerable depth, including between them vast portions of rock, perfectly insulated by the ore or vein stones from the general mass: these, it is evident, could not have existed as fissures for a moment."

I select Mr. Hopkins's excellent results as tending to bring the theory of fissures within the dominion of exact science; rather than the equally ingenious opinions of some other gentlemen, not based on such unexceptionable investigation as his mathematics.

We now approach the last division of our subject, *the filling of the fissures*, and here we again meet Werner, Hutton, Professor Sedgwick, and Mr. Fox.

It has been already seen that Werner thought veins were filled from above; his proofs may be all compromised in the occurrence of masses of the contiguous rocks, and of round stones in the veins. It has been seen that these contained masses always resemble the rock *at that spot* in contact with the vein and not of *superior* rocks. In this county, the well known Relistian *lode* has been often quoted. But whoever will examine the *walls* of this vein will see, that a very similar structure prevails in the rock itself. Nothing is much more common than a spheroidal concretionary form; in the *elvans* it is frequently very well shown on decomposition. I have seen some of the best cases at Tresamble, in Gwennap. In the granite, too, we observe similar nodular concretions, of dark colour and fine grained, and which, "indeed, if sufficiently abundant to predominate over the containing rock, would exhibit a conglomerated structure. In the globular granite of Corsica, however, we have a noted example, in which the constituent minerals are arranged around certain centres, in concentric laminæ." We see therefore that *rock masses* which, by the common consent of geologists of all opinions, are attributed to no derivative origin:—possess the same conglomerated structure. I know of but one case in this county in which I should consider the filling up of a vein to have been mechanical; this is the Badger *lode*, in the Herland Mines, and where we have rounded and angular pieces of granite, slate, and elvan, imbedded in the same felspar clay. In the secondary rocks, however, which Werner studied, it is not uncommon to find even organic remains in the veins; that these are of posterior date admits, I think, of no doubt.

The theories of *injection* and *sublimation* appear both to have been formed from a consideration of volcanic phenomena alone. Here injected veins are of frequent occurrence, and the fissures and rents are doubtless often lined with crystals which may have been sublimed. But will the generalization which has been thus hastily drawn of the analogy of these phenomena to those of metalliferous districts, honestly hold good in the cases before us? In the *universally* recognised volcanic rocks, the veins are of very nearly homogeneous texture, whatever be the containing rock; and, supplied from a common source, it is natural to expect that they would be so. In our *lodes*, on the contrary, the contents of the vein change with a change of rock. Mixed, too, as are the ores of copper, zinc, tin, and lead, are indiscriminately in our veins, with innumerable earthy minerals; if they were ever presented to each other in a state of fusion, would they not chemically combine? We find, however, no such compounds in our veins.

The same objections equally apply to the theory of *sublimation*, for the very idea involves a mode of escape; why then have not the volatile mineralizing substances, sulphur, &c. been dissipated? One would have expected that they would, and if deposited in the veins that they would have separately occupied one portion, the metals, &c. in a pure state; another, and perhaps different situations would have been filled by silica (quartz) and other substances, with which the veins abound. This is certainly as unlike our *lodes* as it is possible to imagine any thing.

We now approach the *segregation* of the eloquent and distinguished Cambridge Professor (Sedgwick), and with this I rather think I tolerably coincide; presuming that Mr. Burr truly interprets it; for I believe we shall all subscribe to the truth of the oxide of tin being deposited on the contemporaneous masses and veins of schorl-rock; we find tin ore very generally accompanying schorl. Indeed, it appears to me little other than the contemporaniety of the veins and rocks. But the professor considers that he can draw a line of distinction between veins of *segregation* and true veins; he has not, however, done so; and I must confess, I doubt his ability to do so in a manner which shall be unobjectionable; for I have already said, I believe the phenomena of the large and the small veins to be identical, and it has been seen that Dr. Boase has already published the same view of the subject.

We come now to the theory recently propounded by Mr. Fox, that veins have originally been fissures gradually opened, and that they have been filled by electric action taking place between the rock masses. The idea of progressive enlargement of fissures has been already considered when speaking of Werner and Mr. Hopkins; the idea of electric filling up was first given by Professor Sedgwick, who says, "after the important experiments of Mr. Fox, there can, I think, be no doubt that the great vertical dykes of metallic ore, which rake through so many portions of the county, owe their existence, at least in part, to some grand development of electro-chemical power." The artificial production of *crystallized metallic* substances, from solutions by the electric action of the solutions alone on each other, was first discovered in France by M. Becquerel, as long ago as 1827, and his experiments anticipate nearly all that has been hitherto done in this country; his list of crystalline metallic substances far exceeds Mr. Crosse's, and they were produced by far more simple means; some account of these ingenious and important discoveries appeared in an English journal early in 1830, but they have only recently attracted the general notice their importance should have at once commanded. I may briefly offer my objections to Mr. Fox's theory, with a hope that the great resources of his powerful mind may obviate them, if worthy of his notice, or the theory to embrace them if they be valid. I have in the discussion of fissures stated my objection to their existence, whether suddenly or progressively formed; and I see no better explanation of the *horses* on the one than the other assumption.

The salts contained in our mine water have not been shown to differ much in the same neighbourhood, and Mr. Fox (although in one case he found ninety-two grains) says, that there are not generally more than from one to five grains in a pint. Besides, *we have yet to learn that these solutions, or any others, will develope electricity in rock masses*: Mr. Fox's beautiful discovery of electric currents *in veins*, being confined to the *veins alone*, for neither in his experiments (yet published) nor my own, *have we ever detected electric currents in the rocks or in the earthy contents of the veins*, the experiments showing nothing but the existence of electricity of the present contents of veins, in their present places. An *experiment* should have *shown* this, or it is nothing but an assumption; a probable one, perhaps, but still nothing more.

Again, it is truly said, that electric currents will pass more readily at right angles, than parallel to the magnetic meridian, and that this explains why the ores are deposited in the east and west veins. But the lodes and cross-courses are all of the same age, and filled at the same period, says Mr. Fox: we have seen that the lodes in St. Just, bear about north and south; here then we have the same agent doing the same work, at the same time, in two different modes. For if the more ready transmission in one direction than another *be the cause of the deposit* of the ores, *why in one case, is it so formed in harmony with that fact, and in another in direct opposition to it*;—and this in both *at the same time?* When, too, we have the assumption of synchronous fissures (forming a considerable angle with the meridian, and through which the transmission would be far easier) which are not metalliferous. Why, too, is some portion of the quartz deposited in the east and west, and others in the north and south fissures by the same agent at the same time?

I offer these objections respectfully to Mr. Fox's consideration, and no one will be more rejoiced than I shall be if he can resolve them. There are many others of equal force, which I reserve, as I fear I have already trespassed too far on your patience.

Let me add, that the fact of parallel *lodes* in the same district, producing similar ores in different rocks, as of tin in slate of Wheal Vor, and in granite at Great Work, and of copper in the one at Consols, and in the other at Tresavean, does not bear out the conclusion that they were deposited by the agency of electricity—the rocks being in opposite states. If so, which is the positive and which the negative formation? and why do similar causes, under apparently like circumstances, produce opposite results?

The facts and observations which I have thus attempted to bring together lead me to conclude:—

1. That the phenomena of our metalliferous districts are not consistent with the idea of the veins having originated in fissures.

2. That the appearances and positions of the *horses* do not countenance the assumption of their having ever supported the bounding planes of *empty spaces*.

3. That the contents of veins varying in different rocks is inconsistent with any theory of their having been filled from *above*, or by *injection*, or *sublimation from beneath*.

4. That the metallic contents of parallel veins in the same district being similar in different rocks, and also in veins in different districts not far apart, at right angles to each other, is irreconcilable with their being filled at the same period by electric agency.

5. That we have no *experimental* knowledge that rocks now are, or ever were, in opposite electrical states; our real knowledge extending to the existence of electric currents in the present *metalliferous* contents of veins, in their present places *only*.

6. That the *heaves* and *slides* are inexplicable on any yet assumed direction of mechanical disturbance, which is consistent with the general simplicity of natural causes; and that synchronous fissures exhibiting these phenomena, are irreconciliable, unless of contemporaneous origin with the containing mass.

7. That there is no line of distinction to be drawn between the intersections of small veins found in hand specimens, and the larger ones, occurring in what have been called *true veins, contemporaneous veins*, and *veins of segregation*.

8. That the only theory yet propounded which agrees with the phenomena is that of *segregation*, and that so far only as it admits the contemporaniety of the veins and their disturbances with the rocks in which they occur.

In submitting the foregoing views I feel I am only exhibiting the opinions which *practical* men in this county have long generally entertained; and I shall be more than amply recompensed for some years of labour I have bestowed on the subject, if I shall succeed in inducing but *one* of them to record the results of his daily experience for the benefit of his successors.

A brief discussion took place at the close, but was confined to topics embraced in the lecture.

PROGRESSION.

Progression, without any conceivable limitation or end, designates the work of the Eternal. Even in his institutions for finite beings, the Infinite provides materials of the imperishable and the everlasting. The germ of science that is rooted in the earth mounts up to the heavens. When we trace the sciences from the earliest period of historical record, we find a multiplying evidence and an increasing light. What is true to-day, is not false to-morrow. Theories may vary, but facts do not change. One theory may replace another; but the laws of the universe always remain the same. They are the decrees of infinite wisdom; and in that wisdom there can be no variableness, or it would not be infinite. * * * The earth itself relates its own history. No historian ever composed such a narrative of extraordinary events, or depicted them in such intelligible characters. The geological history of the earth tells us that there was a period when there was not a living being upon the surface of the globe. The primary rocks have not yet been found to contain a single fossil, or any vestige of animal life. The first forms of life that were placed upon the habitable globe seem to have been of the most simple kind; and successive generations of these grew up and perished, lived and died, before beings of more complicated structure were introduced. The scale of being commenced with a simple living fibre or tube, like the polypi, with an inherent tenacity of life, that does not belong to organizations with more instruments of sense, more complexity of structure, or more extent of powers. Lichens, and mosses, and ferns, appear to have been among the first specimens of vegetable existence. The different strata of the earth are vast pages in the geological history of ancient, but unnumbered days, which exhibit the recruements of extinct species of animated beings, that successively inhabited the earth and the ocean; of which we know that they have been, but have ceased to be. Whole generations of beings that once were, have perished without leaving any living progeny: and the only memorials which they have left of themselves, are in their forms or skeletons that have been preserved in the ancient stratifications of the globe. * * * * It seems to be the benevolent scheme of the Infinite, with respect to his creatures, to make a beginning of their being, in a low state of pleasurable existence; and by a slow progression, or through a series of mysterious and inscrutable changes, to advance them to a higher. If the first state be the smallest portion of happiness that is compatible with a balance of good, it must be recollected that progressive advancement is the order of the universe, or, rather, the design of the great Father of the universe. And is not a minimum of good, with a perpetual increase, preferable to a greater abundance in the first instance, but without subsequent or endless augmentation? Good perpetually increasing must be preferable to stationary good; even though that good be high in the degree of enjoyment and the scale of happiness. Progressive good seems most in unison with the constitution of the world, and with the fond desires and natural expectations of man.—*Religion of the Universe, by Robert Fellows, LL.D.*

PROCEEDINGS OF SCIENTIFIC MEETINGS.

GEOLOGICAL SOCIETY.—Wednesday, Dec. 14;

Mr. Lyell, President, in the chair.

Four papers were read.—The first, by Mr. Babbage, gave an account of certain impressions in the Farewell rock, one of the lowest beds of the South Wales coal measures. They are considered by the country people to be the marks of horses hoofs; but the author, on carefully examining the impressions, found that the part which should have received an indentation from the frog was in relief, and rather resembled the frog itself. He alluded also to the frequent occurrence of similar impressions in the old red sandstone of Forfarshire, and there called Kelpies feet. In attempting to account for these marks, Mr. Babbage described some observations recently made by Mr. Lyell on the impressions left by Medusæ on a soft beach; and stated that though Mr. Lyell did not find the resemblance so exact as to authorise the conclusion, that the sandstone casts were due to animals of that description; yet that it was sufficiently near to invite further observation, and to render it desirable to have accurate drawings made of the marks, which different species of Medusæ may leave, when thrown by the tide on soft mud or sand.

The second communication was an account by Dr. Buckland of silicified trunks of large trees in the lower portion of the Poikilitic, or new red sandstone series at Allesley, near Coventry.

It has been long ascertained that the gravel which is so extensively distributed over that part of Warwickshire, contains, in great abundance, fragments of silicified wood; but their original matrix was unknown. In the spring of the present year, however, Dr. Buckland was informed by Mr. Bree, of Allesley, that part of a silicified tree, several feet in length and a foot and a half in diameter, had been discovered in the garden of Mr. Gibson. On visiting the spot in October last, the author determined that the tree was imbedded, not in the superficial gravel, but in that portion of the new red sandstone of the district, which consists of strata of indurated sandstone, with interspersed quartz pebbles, and of conglomerates similar to those which occur in the lower division of this series in Cheshire and many other countries. A short time since another but larger tree was dug up and destroyed in altering a road near Allesley. On comparing portions of the tree in Mr. Gibson's garden, and which, it is worthy of remark, is carefully preserved in its matrix, with fragments obtained from the gravel, Dr. Buckland found so perfect an identity in mineral condition, as to have no doubt that the latter were derived from denuded beds of the new red sandstone. The characters of the fossil wood were then described, and it was stated that all the specimens hitherto examined appear to be referable either to Coniferæ, or to those compact woods in which no large vascular tubes or concentric lines are visible, and which now grow in regions where little or no check to vegetation is produced by change of season. The value of the discovery to geology was also explained in reference to several kinds of fossil wood, which have been long obtained from beds of a similar nature in Saxony, particularly at Chemnitz, near Dresden.

Mr. Stokes then read some additional remarks on a partially petrified piece of wood from a Roman aqueduct at Eilsen, in the principality of Lippe, Buckelburg, and discovered by M. Cotta, of Tharand. In a former communication Mr. Stokes hazarded the conjecture, that the cylindrical petrified portions might be due to the wood having received an external supply of carbonate of lime, to particular points, from stalactites formed in the building. Having, however, been recently shown, by Mr. Robert Brown a specimen of the same wood, which afforded greater facilities for examination, he has ascertained that the petrified portions are not continuous cylinders, but spindle-shaped bodies, about two inches in length, and, being completely surrounded by the wood, could not have been formed by stalactitic depositions. Mr. Stokes also mentioned Mr. Brown's having pointed out the remarkable circumstance, that though the change in the longitudinal fibres of the petrified portions appears to be complete, yet the medullar rays preserve occasionally their ligneous state. In this additional specimen the author likewise found, that in those portions which present the characters of sound wood, there is a greater quantity of calcareous matter generally diffused, than in those which have undergone certain stages of decay, the line of separation between the two conditions of the wood being in some places remarkably well defined. The communication concluded with some observations on the Allesley wood described in Dr. Buckland's memoir; and on the assistance which the specimens from the Roman aqueduct afford, in investigating the first processes in the mineralization of vegetable remains.

The fourth paper was a description of a raised beach in Barnstaple and Biddeford Bay, by Professor Sedgwick and Mr. Murchison.

During a recent examination of Devonshire, the authors discovered a raised beach, which forms, at intervals, a series of low cliffs from the mouth of the Taw to the bold headland of Baggy Point, a distance of three miles. The greatest thickness of the beach is forty-five feet, and its base is about three feet above the highest tidal level. The top presents eight or ten feet of angular fragments of the adjacent rocks, imbedded in clay. Beneath this superficial covering are twenty-five feet of finely laminated sand passing downwards into masses of hard calcareous grit, and the base of the beach consists of an undurated conglomerate or shingle which fills up the inequalities in the surface of the ancient rocks constituting that part of Devonshire. The thickness of these lower beds is about eleven feet. The sands are generally arranged in horizontal layers, but they sometimes present that appearance of false bedding so common in tertiary and secondary formations. Fragments of shells of existing species, occur in the sand as well as in the calcareous grit and conglomerate. Though the base of the beach, as already stated, is generally not more than three feet above high-water mark, yet at Baggy Point it rises rapidly to the north to an altitude of seventy feet; and the shingle bed is in parts nineteen feet thick, thus presenting the greatest quantity of coarse materials at the point where it attains the greatest elevation. The authors then detailed further evidences of change of level in that part of Devonshire, and afterwards offered some remarks on the raised beaches in Cornwall, which have been described by other geologists. With respect to the characters which they present in that county, it was stated that the beaches might be divided into three classes. 1. High shingle beaches, or accumulations formed at high-water level on rocky shores. 2. Mid-water beaches, composed of pebbles and fragments of shells more or less confusedly disposed. And, 3. Low-water beaches, made up of beds of small gravel alternating with sand and layers of shells, and formed below the line constantly covered by the sea. Of the first of these classes, the raised beds of coarse shingle and rounded blocks near the Land's End were mentioned as examples; of the second, the elevated shingle beach at Plymouth; and of the third, the ancient beaches north of St. Just's Bay and south of New Quay. The paper farther explained why there are no vestiges of similar phenomena on coasts formed of precipitous cliffs, or on the opposite low shores of Pembrokeshire. With respect to the latter, it was shown that the mounds of blown sand, by which they are bordered, have for ages ceased to increase; and it was, therefore, inferred, that the sandy beaches which once supplied the loose materials are now permanently submerged beneath the sea.

STATISTICAL SOCIETY.—Nov. 2.

G. R. Porter, Esq., in the chair.

The Rev. Mr. Boone and M. Bass, Esq. were elected members.

On the table, among numerous presents of books, we noticed particularly a copy of the last edition of 'The Complete Book of the Girdle Wearers;' a curious Chinese work, in half a dozen square scarlet *brochures*, presented by James Calder Stewart, Esq., of Canton. This 'Tsin-Shin Shoeen Shoo' (the original title) contains an official list of all the chief civil, military, and ecclesiastical officers of the Chinese empire. Being corrected periodically, for the exclusive use of the government servants, the possession of it is prohibited to Europeans. Its contents embrace a view of the general framework of the Chinese political system more authentic and complete than is obtainable from any other native source.

The first paper read was an abstract of the proceedings of the Statistical Section of the British Association, at the meeting held at Bristol, August 22, 1836; by Henry Hallam, Esq.

The second paper read was 'On the Application of Statistical Facts to Statistical Science;' by William Atkinson, Esq. The object of the author was to show the necessity of having more certainty and consistency in the principles of commercial economy than at present exist. After some preliminary remarks on the expediency of occasionally deviating from the leading regulation of the society, which limits the duty of its members to the mere collection of facts, forbidding the expression of opinion, he proceeded to prove, by a critical comparison of numerous passages from the principal writers on the causes of wealth, as Smith, Say, Ricardo, M'Culloch, Scrope, &c., that their statements are involved in great confusion and contradiction; that, up to the present time, we are most lamentably destitute of any certain knowledge in the great branch of statistical science which relates to commerce; and that, in order that the principles of commercial economy may be established on a sure and certain foundation, they must be formed, not upon *à priori* assumptions and definitions of vague abstractions, but upon positive facts, to be observed, collected, and arranged by the science of statistics.

After the reading of Mr. Atkinson's paper, an animated discussion arose upon the question, whether statistics be or not a *science?* and whether it should be an object of the Statistical Society, not merely to collect statistical facts, but to make inductions, and draw conclusions from them. The proposition of deviating from the original purpose of the society, by expressing opinions, and forming systems on the facts collected, was disapproved of by Mr. Hallam and others, as belonging to the province, not of statistics, but of economy; and as tending directly to transform a Statistical into an Economic Society. While we properly appreciate the abstract expediency of avoiding, in a newly-formed society, the prejudicial consequence of introducing party contention, we cannot, in the case of statistics, perceive the liability of incurring any danger in promoting the formation of legitimate inductions from data accumulated by the society; because if these data are *facts*, and such a society could adopt them only as such, there can be but one conclusion made, and that must be the *truth*. As to statistics being a science, could authority decide the question, it would be easy to adduce that of all the most distinguished writers in Germany, the native land of statistics, and in France. What is science? Is it "something," as Aristotle has it, "which we *know*," in contradistinction to art, which is "something which we *do?*" Does true science consist, as Bacon declares, in "the knowledge of facts?" Then statistics is a science. It possesses the five constituent elements of a science, as enumerated by the French ideologists, namely, Facts, Nomenclature, Systematic Classification, Theory, and Method. "Science," says Sir John Herschel (Treatise on Nat. Philos. p. 18), "is the knowledge of many, orderly and methodically digested and arranged, so as to become attainable by one." The knowledge of reasons and their conclusions constitutes *abstract* science; that of causes and their effects, and of the laws of nature, constitutes natural science. The inductive process of illation forms a science. The synthetic process of illation produces art: every art is therefore posterior to, and exists only in virtue of, its correlative anterior science, of which it is the effect. Statistics, therefore, like other subjects of human thought, may be viewed both as a science and an art. Considered as a process of inference from particulars to generals, or from many to one, it is a science; and considered as the application of general principles to individual cases, it is an art—precisely the same as any other subdivision of the natural and abstract sciences. Those who sneer at art as something very contemptible, should be reminded that every art is the legitimate offspring of a science; and that the principles of art are the result of scientific induction. Every rational act has reference to an *à priori* theory—a preconceived principle obtained by reasoning scientifically from the particular to the general, or, as logicians phrase it, from the concrete to the abstract. If the march of intellect be a desirable march, it assuredly is more important to proceed *securely* than *rapidly*, never forgetting the great Baconian maxim, "Hominum intellectui non plumæ addendæ, sed potius plumbum et pondera." Without the observation, examination, and classification of facts, which it is the business of statistics to supply, statesmen and philosophers may dogmatise on complex abstractions and combinations, with useless, and often pernicious, temerity; but no progress can h be made towards the temple of truth and happiness.

RATIOS OF GOLD TO SILVER.

The Ratios of Gold to Silver from 1760 to 1829, with the Averages for each Ten Years, and the total Mean Average for Seventy Years:—

(Taken from the Appendix to a Report of a Select Committee of the American Congress on Coins, June 30, 1832.)

Years.	Pure Gold to pure Silver.	Average for Ten Years.	Years.	Pure Gold to pure Silver.	Average for Ten Years.
1760	14.29 to 1		1795	14.77 to 1	
1761	13.94 .. 1		1796	14.77 .. 1	
1762	14.63 .. 1		1797	15.45 .. 1	
1763	14.71 .. 1		1798	15.45 .. 1	
1764	14.91 .. 1		1799	14.29 .. 1	14.94 to 1
1765	14.69 .. 1		1800	14.81 .. 1	
1766	14.41 .. 1		1801	14.47 .. 1	
1767	14.45 .. 1		1802	15.23 .. 1	
1768	14.58 .. 1		1803	14.47 .. 1	
1769	14.45 .. 1	14.51 to 1	1804	14.67 .. 1	
1770	14.35 .. 1		1805	15.14 .. 1	
1771	14.36 .. 1		1806	14.25 .. 1	
1772	14.19 .. 1		1807	14.46 .. 1	
1773	14.73 .. 1		1838	14.79 .. 1	
1774	15.05 .. 1		1809	16.25 .. 1	14.85 to 1
1775	14.62 .. 1	14.3	1810	16.15 .. 1	
1776	14.34 .. 1		1811	15.72 .. 1	
1777	14.04 .. 1		1812	15.04 .. 1	
1778	14.34 .. 1		1813	14.53 .. 1	
1779	13.89 .. 1	14.49 to 1	1814	15.85 .. 1	
1780	14.43 .. 1		1815	16.30 .. 1	
1781	13.33 .. 1	13.9	1816	13.64 .. 1	
1782	13.54 .. 1	14.8	1817	15.58 .. 1	
1783	13.78 .. 1	——	1818	15.42 .. 1	
1784	14.90 .. 1	28.7	1819	15.82 .. 1	15.41 to 1
1785	15.21 .. 1	14.3	1820	15.71 .. 1	
1786	14.89 .. 1		1821	15.98 .. 1	
1787	14.83 .. 1		1822	15.91 .. 1	
1788	14.71 .. 1		1823	15.91 .. 1	
1789	14.89 .. 1	14.45 to 1	1824	15.64 .. 1	
1790	15.01 .. 1	14.7	1825	15.69 .. 1	
1791	14.95 .. 1	14.9	1826	15.69 .. 1	
1792	14.43 .. 1	——	1827	15.77 .. 1	
1793	15.01 .. 1	29.6	1828	15.77 .. 1	
1794	15.32 .. 1	14.8	1829	15.95 .. 1	15.80 to 1

Total Mean for 70 years.......... 14.92 to 1.

A Table of the Prices in the Market of Gold and Silver, from 1760 to 1819, taken from Wetenhall's Lists, and exhibiting the relative prices of Gold and Silver to each other.

Standard Silver. Lowest. s. d.	Highest. s. d.	Average. s. d.		Gold. £ s. d.		Av. for 10 years.	
1760 .. 5 3½	1764 .. 5 9½	5 6¼	per oz.	3 19 5	13½ to 14½	14 3	14 3
1765 .. 5 3½	1769 .. 5 7½	5 6	..	3 19 2	14¼ .. 14¾	14 4	
1770 .. 5 2½	1774 .. 5 8¼	5 5¾	..	3 19 1	14 .. 14$\frac{9}{10}$	14 4	14 3
1775 .. 5 2	1779 .. 5 9	5 5	..	3 17 7	13½ .. 15	14 3	
1780 .. 5 3	1784 .. 5 10¼	5 7	..	3 17 8	13¼ .. 14¾	13 9	14 3
		5)27 6		5) 19 12 11			
		5 6	..	3 18 7¼			
1785 .. 5 1½	1789 .. 5 3¼	5 3	..	3 17 6	14½ .. 15½	14 8	
1790 .. 5 1½	1794 .. 5 4½	5 4¼	..	3 17 6	14¼ .. 15¼	14 7	14 8
1795 .. 5 0	1799 .. 5 6	5 3	..	3 17 6	14½ .. 15½	14 9	
1800 .. 5 4	1804 .. 5 10½	5 8¼	..	4 3 9	13¾ .. 15	14 3	14 9
1805 .. 5 4½	1809 .. 5 9	5 7	..	4 4 2	14½ .. 16½	15 5	
1810	1814	6 3¼	..	4 18 0	14½ .. 16	15 2	15 2
1815	1819	5 5¼	..	4 3 4	14¾ .. 15½	15 2	

DR. BUCKLAND'S BRIDGEWATER TREATISE.

TO THE EDITOR OF THE MINING JOURNAL.

Sir,—When I wrote you on the 31st ult., my conviction and expressed opinion was, that Dr. B. would never descend from the dazzling eminence to which science had raised him by the voice of his admirers, to answer any remark on his work, that had gained for him all that an author could desire. And why did "Britannicus," being one of those who cultivate a noble and useful (?) science, waste the time he might so nobly and usefully employ? or stoop so low as to notice my letter? said by him to be a "singular compound," containing "arguments betraying total ignorance of the subject," and "remarks too absurd to require notice or refutation." Yes, why do so, if "too absurd to require" it? seeing, moreover, I am one who, on the "principle" followed by "the Inquisition, would, in default of the stake in this world, consign the geologists to the torments of hell in the next;" because, says "Britannicus," he, "knowing as much (*qy.* how much, or any thing?) as the inquisitors of the true scope of the Bible, would have them to square their observations with his ideas of what that sacred book asserts." But let us see: this same letter is an "erudite letter," and contains scientific observations "ably propounded;" and it turns out to be "the duty of 'Britannicus' to protect a noble and useful science against misrepresentations." Is this candour, or common sense, or "Christian charity?" so much complained of as wanting in me. He, too, seems to have "a beam in his own eye;" I shall not, therefore, cast my "pearl" before him, be its worth what it may. With the following remarks I shall take leave of the subject, unless called to it by more honesty than is apparent in "Britannicus," for he makes me say what I never thought of; and with less virulence too, for his "fury has blinded him" so much, that had he not quoted some passages I can recognise, I should say he never read my letter at all.

1. "We can readily understand the loud applause which Dr. B.'s late announcement drew forth from numbers who have no such scruples, when they found so important a convert had at length openly subscribed to the latitudinarian principles of interpretation which geology has long inculcated. It is, therefore, the more alarming to thousands of unscientific believers in the Word of God, to find the commencement of innovation thus countenanced, as it were, by the church;" and the more so, when they have Dr. Johnson, Dr. Watson, and others to support them in their belief of the Mosaic history of the creation.* And that many, not of "the Vatican" or "the Inquisition," have looked even upon the Dr. B. himself a little suspiciously, may be gathered from the fact (being present myself) of his gaining marked applause at one of the most respectable and scientific meetings in the west, for only saying in explanation, that "by nature we (geologists) mean the Deity, and only use the term Nature out of reverence; and that this had been ably explained by Cuvier."

2. In reference to "one observation" of mine, said to be "made in fury that blinded me," respecting the mortality of "animals," I refer "Britannicus" to that part of my letter containing that subject. I again ask, "Could these (the inferior creation) die until after the introduction of death?" Will "Britannicus" explain what he means in the paragraph written by him on this point? He is certainly very obscure here. Will he turn out what appears to him so dreadful? I think "death stares him in the face;" and I hope his fright will not be increased, when I tell him the very ground was "cursed" "for man's sin."

3. I am not acquainted with "The Pulpit," but quote the Doctor himself from the "Bridgewater Treatise," who quoted Dr. Chalmers, from his "Evidence of Christian Revelation," chap. 7th; and I again assert, the quotation "is a string of questions" only, whatever might have been the opinion of Dr. C.

4. That Moses was wise, I quoted the Scriptures to prove, Acts vii. 22; that the Egyptians were so, I quoted one of the first antiquarians and eastern scholars of modern days. Of the exact age of chemistry I know as much as "Britannicus," who does not tell us that "the genius of ancient philosophy was" always "decidedly averse to experiment," the base upon which chemistry stands; but that a period has existed when it did I will not deny. But "in Egypt, however, many processes appear to have been carried on which implied at least very considerable acquaintance with what we should call chemical facts, such as painting on glass, fabricating porcelain, gilding of metals, extracting salts from their bases, separating oils, and preparing wine and vinegar. The dyeing of silks too was common among the ancient Egyptians; and the process of embalming was, of course, a chemical one; they likewise worked considerably among metals." I might also quote the history of the "Phœnicians" and "Chinese." I might name Hermes Trismegistus, Geber, Artephius, and Roger Bacon, in proof that some at least of the ancients were not "averse to experiment," although much must be deducted from the history given of them by the earliest alchemical authors. But this is all foreign to the subject, as almost all "Britannicus's" letter is.

5. I never started "the idea that geologists would have thrown the date of the Mosaic deluge, and the subsequent changes of the earth's surface, further back, unless guided in this respect by Scripture chronology." Let "Britannicus" read this part of my letter again more coolly. I adverted to "facts," and their "history," far more modern than even the New Testament; and until I can be furnished with a far better theory of the deluge than any yet given, I shall claim a right to think for myself of the changes that might (in the hands of the Deity) have then taken place, preparatory to what may have since been perfected or presented to our view.

6. In respect to Infinite Power. Where have we "abundant evidence that any such instantaneous exercise of Divine Power has not been manifested" in the production of a coal-field? Time is now an agent to mature "the oak;" but time is no agent to the Deity; it is his creature, and is only useful to mankind relatively.

7. Science, I know, has proved many things we were once ignorant of; instance the rotundity of the earth, its place in the system, &c. &c.; but science, sir, "sublime science," can never prove what is intended to be taught by the new philosophy, viz. "the prolonged ages or days of creation, when numerous tribes of the lower orders of aquatic animals lived and flourished, and left their remains imbedded in the strata that compose the outer crust of our planet;" and "that there has been a period, and that too of no inconsiderable duration, when they alone were the tenants of the globe;" and "that the genealogies of man do not fix the antiquity of the globe." But "Britannicus" flies "off with a tangent" from this and all that I take my stand upon: this is not fair if he wants to dispute.

8. Whatever station may be occupied by "Britannicus" in society, science, or literature, he will lose rather than gain even by defeating me, who place myself so low in either class. I am, however, a member of the "Established Church;" and as "a cat may look at a king," so I thought a communicant might ask a few questions on a work written by a dignitary of that church (I have advanced no dogmas of my own); for I wot not that "Dominie and the hot pincers" were to prevent doubts being expressed, or to bind all that is written by science on the conscience of the reader, although the writer be a Buckland or a Sedgwick.

To conclude, sir. If I have "insinuated" that all geologists have "no religion at all," I crave forgiveness; I never intended it; nor can I find it in my letter. Pity me also if I have had a "bad sample" of them in my "assay." I honour and respect Dr. B. as a man of science, and do not think so badly of him as "Britannicus" states; but I will not shrink from his superior's superior in the point at issue. I am not learned, but can draw an inference. Of the Scriptures, I say we must believe all, or the whole will be torn from us. Had any one not a minister of the Gospel wrote the "Treatise," I should, perhaps, never have troubled you.

Germanicus.

* A friend of mine being once in a bookseller's shop heard a boy ask for the "second volume of the 'History of the World before the Creation.'" I need say the joking urchin was obliged to fly. Not so now; we have vols. first and second too.

Gold Mines.—The gold mines at the south appear to be yielding liberally the precious metal. Hughes's mine in Fluvanna county, Va., with ten hands employed and one small mill, affords an average of more than $100 per day. A mine on Col. Bowles's land, in the same vicinity, is said to be still richer. Says a letter from Fluvanna, published in the *Richmond Enquirer*, "The day is just dawning on gold mining in this region of country, and it must contribute largely to the sound currency which is endeavoured to be established."—*Charlotte Journal (U.S.)*

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